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ALBION'S MUNICIPAL WATER

Report of the Municipal Water Fact-Finding Committee

GREATER ALBION ALLIANCE 2000

REL to end

Second Edition

Albion, Michigan, December 4, 1996

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ALBION'S MUNICIPAL WATER

1 Introduction.

Water is plentiful in Albion, but citizens and especially newcomers and visitors have complained about its quality for decades.[1] The water is hard. It tastes and sometimes smells bad. It stains laundry and plumbing fixtures with rust and sediment. Aesthetic concerns, not safety issues, seem to underlie most complaints.[2] Varied plans to treat the water have been proposed, and limited treatment began in July 1991. The discovery of small amounts of chemical pollutants in city wells in 1981 and 1988 added urgency to the debate about treatment.

A study committee[3] originally prepared this report for the Special Projects Committee of the Greater Albion Chamber of Commerce in 1991 to help that group take a position on water treatment. The study committee also intended its report to provide enough facts about the city's water system, known and possible problems with the water, and treatment possibilities to help anyone make informed decisions.

The committee reconvened in 1996 when the Albion City Council voted to proceed with a new wellfield and iron-removal plant. The Special Projects Committee meanwhile had evolved into the Greater Albion Alliance 2000. The committee surveyed additional information and produced this revised report.

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[1] Forty-eight per cent of 230 randomly selected Albion households surveyed in 1990 identified water quality as the local government service the respondent would most like to see improved. The survey was "open-ended"; questions were asked, but no answers suggested. Sixty respondents volunteered remarks which ranged from mild comment ("Water needs to taste better.") to blunt criticism ("The water tastes foul, is filthy and contains who knows what.") to laments ("It is a shame to live in a city where you can't drink the tap water.") Economic development, with 16% urging improvement and 22 offering comment, ran a distant second as a concern. Albion Civic Life Project, "Albion, Express Yourself!/Community Survey Open-Ended Responses," 1990, pp. 4-5.

[2] But only safety is now subject to mandatory regulation. ". . . U.S. EPA [Environmental Protection Agency] does not care how much your water smells, what it tastes like, how much it stains, or what color it is, so long as the health of the water user is not affected." Jones & Henry Engineers, Inc., *City of Albion, Michigan/Water Treatment Plant Study*. Lansing, 1988. See Section 3.2.

[3] Members of the original committee were David G. Moore, chair; Robert Dininny, Terence J. Fitzwater, Ralph A. Lange, William K. Stoffer, Lawrence D. Taylor, and Melvin L. Vulgamore.

2 The City of Albion's Water System.

The City of Albion provides water to most residents, businesses and industries in the city.[4] There are a few households with private wells.[5] The city also furnishes water to some residences and businesses outside the city limits under private and intergovernmental agreements.[6]

2.1 *History.* The municipal water system dates from 1885. The newly incorporated City of Albion floated a $50,000.00 bond issue for construction, followed a short time later by another issue in a like amount.[7] Originally two six-inch wells[8] flowed into a brick reservoir.[9] Pumps--steam until 1906, then electric--in the E. Cass Street water works building (more recently the Albion Recycling Center) forced the water into city mains. In 1909 a 250,000-gallon reinforced concrete surface reservoir was built immediately south of the water works building. It captured the flow of three new eight-inch artesian wells. From 1885 until 1915, when a pumping station was built on N. Albion Street, the E. Cass Street wells provided all the city's water[10]. The 1916 Albion Street station had two wells equipped with steam-driven pumps and a capacity of 2 million gallons a day. With the 3 million-gallon-a-day capacity of the Cass Street pumps, the city had a total capacity of 5 million gallons a day. Both facilities served the city until the early 1950s, when a new well was drilled on N. Albion Street and the city began developing the Clark Street well field.[11] The concrete reservoir and a columnar standpipe earlier erected in Crowell Park, immediately to the north of the present elevated storage tank, served the city until 1961. The reservoir was demolished that year, and the standpipe upon completion of the new storage tank in early 1962. The new tank was part of a series of improvements to the municipal water system in 1960 and 1961 which included the construction of more than four miles of new mains[12] and the development of the Brownswood Road well field.[13] The improvements were funded by a $340,000.00 water bond issue approved by the electorate in 1960. That was the last large water system improvement in the city. There have been several relatively small water-main construction projects in the intervening years, either to improve circulation or to extend service.

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[4] Chapter 17 of the city's 1960 charter reserves to the city the power to "construct, own, operate, improve . . . public utilities for supplying water . . . to the municipality and the inhabitants thereof." The water department is administered as part of the Department of Public Works.

[5] The Locust Lane subdivision, for example, is not served by city water, and there are other isolated wells. There is no legal requirement that any water user in Albion connect to the municipal system, although adoption of such a requirement is under consideration. See also footnote, Section 7.2.

[6] City water has long been furnished to some Sheridan Township businesses and industries along N. Clark Street, and residences there and on E. Michigan Avenue and Sunnyside Court east of the city. It was provided to the Albion Holiday Inn (now the Days Inn) when it was built in 1967. City water was further extended into Sheridan Township east of N. Clark Street and north of Michigan Avenue after aquifers in that area were found to have been contaminated at the former McGraw-Edison plant site, described in Section 3.3.2.

[7] *Albion's Milestones and Memories*, Three-Quarters-Century Club (1935), p. 62.

[8] *Albion's Milestones and Memories*, p. 62.

[9] *Albion Evening Recorder*, "Cass Street Water Reservoir Is Razed, Closing an Era." Nov. 10, 1961, p. 1.

[10] *Recorder*, Nov. 10, 1961.

[11] Historical information provided in 1991 by William L. Rieger, then director of public works, City of Albion.

[12] *Albion Evening Recorder*, "City Accomplishments Numerous This Year." Dec. 29, 1961.

[13] *Albion Evening Recorder*, "City Water Improvements To Be Completed Within Next 7 Months--Rieger." Jan. 17, 1961.

2.2 *Well Sites.*[14] The city water system now includes seven wells. There are three wells in the Brownswood field, on the city's west side near the wastewater treatment plant, and one nearby just off N. Albion Street north of the Kalamazoo River. Across town, there are three wells in the Clark Street field, at Ketchum Field. The pumps have a combined capacity of 12.1 million gallons a day.[15] The Albion Street well has provided only standby service for 30 years or more.[16] The Brownswood Road wells have likewise provided only standby service since 1988.[17] Since 1988 the Clark Street wells have regularly supplied all the city's water.[18]

2.3 *Water Sources.*[19,20] Two distinct aquifers (rocks or sediments which contain water and allow water to move through them) occur beneath Albion. An upper aquifer consists of unconsolidated (loose) glacial sediments containing sands, gravels and clays, which vary in thickness from 10 to 60 feet. The water table (the level below which sediments or rocks are saturated with water) is typically encountered at a depth of 10 to 15 feet. The lower aquifer is the Marshall sandstone, from which Albion draws its water.[21] It is a vast formation of porous stone which underlies several hundred square miles of central lower Michigan.

Both aquifers are abundant sources of water. They are separated by thin, discontinuous clay layers. The clays act as aquitards (barriers to groundwater flow). There are enough breaks in the clay, however, to allow some of the water from the upper aquifer to flow down into the lower aquifer.

Groundwater in the upper aquifer tends to flow toward the Kalamazoo River. Flow in the lower aquifer is more complex and is generally to the west or southwest, as controlled by structures within the rock. The sands and gravels of the upper aquifer and the sandstone of the lower aquifer are very permeable. That means that the many interconnecting spaces in the rock or sediment allow the water to move readily through the rock, and water can be easily pumped from the aquifer. It also means that liquid pollutants can penetrate the aquifer and move through it. Aquifers gain their water from the downward percolation of rainwater, and may become contaminated if the surface area that receives the rainwater is not protected from pollution. However, low concentrations of pollutants are diluted by the surface water and are filtered by the sediment and rock as the water moves downward to the water table and then through the aquifer.

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[14] See map, Appendix A.

[15] The wells are the Clark Street No. 1 (1952), 1,200 gallons per minute (g.p.m.); Clark Street No. 2 (1954), 1,000 g.p.m.; Clark Street No. 3 (1966), 1,450 g.p.m.; Albion Street (1951), 1,000 g.p.m.; Brownswood No. 1 (1961), 1,250 g.p.m.; Brownswood No. 2 (1961), 1,250 g.p.m.; and Brownswood No. 3 (1961), 1,250 g.p.m. City of Albion, *1992 Annual Water Department Report*, p. 39.

[16] Committee interview with William L. Rieger, director of public works; Stanley Sommer, water department superintendent, and Kevin Markovich, city chemist, Oct. 17, 1991.

[17] See Section 3.2.5.

[18] The three Clark Street wells, from which almost all city water has been pumped since the Brownswood contamination was detected, have a combined capacity of 5,256,000 gallons a day, well in excess of the maximum daily production in 1995 (2,748,200 gallons on May 3, 1995). *1992 Water Department Annual Report*, p. 33; information provided committee, November 1996.

[19] Except as noted, the information in this paragraph is supplied by committee member Lawrence D. Taylor, Ph.D., professor of geology at Albion College.

[20] For an accessible general treatment of the geology and aquifers of Calhoun County, and of groundwater resource issues, see *The Water Below/A Subterranean Saga of Groundwater in Calhoun County*, Western Michigan University (a Groundwater Education in Michigan regional center), Kalamazoo, no date on title page.

[21] The name follows from the practice of naming geological strata for places where outcrops occur or are prominent. The Marshall sandstone is also exposed near Albion, including some rocky faces along the Homer branch of the Kalamazoo River southwest of the city, and at the "swimming hole" in Albion College's Whitehouse Nature Center.

2.4 *Uses of Water Supplied by City of Albion.* In 1995, the City of Albion pumped 703.7 million gallons of water, down from 754.3 million gallons in 1994.[22] Annual water production exceeded 1 billion gallons every year from 1954 through 1979, and peaked in 1967 at 2.3 billion gallons.[23,24] Of the water sold in 1992,[25] 51.9% was to industrial users, down from 60.9% in 1990. Declining sales to the largest users suggest that the downward trend continues. The five largest industrial users in 1990 were Hayes-Albion Corporation, 852,288 gallons per day; Guardian Industries, 305,348 g.p.d.; Union Steel Products, 26,727 g.p.d.; Reed Plastics, 84,182 g.p.d., and Pickens Plating, 23,588 g.p.d. By 1995, their use had dropped in every instance.[26] That year, Hayes-Albion used 601,056 g.p.d.; Guardian Industries, 116,196 g.p.d.; Reed Spectrum, 33,951 g.p.d., and Pickens Plating, 3,414. Union Steel had closed. The city gained one significant new industrial user, J & M Plating, which used 38,683 g.p.d. in 1995. The largest non-industrial user in 1992 was Albion College, with 172,142 g.p.d. or 9.6% of consumption.[27,28] All other metered users (commercial and residential) accounted for 694,718 g.p.d., or 38.5% of consumption.[29]

3 Quality of Water.

3.1 *Complaints.* The principal complaints about water quality involve objectionable taste, odor (in particular a sulfurous or "rotten egg" smell), turbidity (lack of clarity), and red or black staining of clothing, showers, plumbing fixtures and even hair. High mineral content, and in particular the presence of suspended mineral compounds, causes expensive maintenance problems.[30] Iron and manganese give water fresh from the wells a metallic taste. Engineering studies and reports have also blamed hydrogen sulfide,

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[22] Information furnished by City of Albion Department of Public Works, November 1996.

[23] *1992 Water Department Annual Report*, p. 38.

[24] Water production in the Albion system is measured in gallons, but water is metered for sale in cubic feet. A cubic foot of water is 7.48 gallons.

[25] The last year for which a comprehensive annual report of the City of Albion Department of Public Works is available. Budget constraints and staff limitations have precluded the report's compilation since then. Some of the figures stated in this section were extracted from department records at the committee's request.

[26] Information furnished the committee by the City of Albion Department of Public Works, November 1996.

[27] Even as industrial production declined, Albion College's use increased in both absolute and relative terms. The 1992 figures are up from 149,600 g.p.d., or 6.8% of production, in 1990.

[28] 1995 water use by Albion College could not be readily obtained because its facilities are served by more than 100 meters and the totals would have had to be compiled by hand.

[29] *1992 Water Department Annual Report*, pp. 48-49.

[30] Albion College is in a unique position among the city's large water users because most of its water supplies the personal needs of 1,580 students. Besides spending thousands of dollars annually ($20,919 in fiscal 1995-'96) for salt for ion-exchange water softeners, the college devotes many hours to maintaining plumbing in its buildings. Suspended materials clog Sloan valves (which control direct-pressure flushing of toilets and urinals), pipes and other fixtures. Controlling swimming pool chemistry is difficult, and special treatment is needed for water used in the central steam plant and central chilled-water cooling plant. The college annually replaces tile and grout damaged by chemicals used to remove iron and manganese staining.. There is anecdotal evidence that prospective students have not come to Albion College, and that students have withdrawn because of objections to water quality. However, student complaints are reported to have diminished since 1991, and maintenance problems are also apparently fewer. Whether that is a result of the city's polyphosphate and disinfection treatment begun in 1991, or the college's own more intensive treatment efforts, is not known. Interview with Kenneth R. Kolmodin, director of facilities operations, Albion College, Sept. 18, 1991, supplemented by correspondence with the committee November 1996.

iron bacteria, and increased water temperatures in warm weather for the taste and odor problems.[31]

3.2 *Analyses of Impurities and Contaminants.* Virtually all of the impurities found in Albion's water as it comes from the ground are of natural origin. Mineral salts dissolve in rainwater as it percolates through soil, sediments and rocks. Only trace amounts of contaminants originating from human activities have ever been found in Albion water, but there are significant threats to the water system from known areas of soil contamination. The action of bacteria in the distribution system may alter the chemistry of the water. Water can be contaminated by bacteria, although no harmful bacterial contamination has been found in the past. The water supply has been continuously treated with chlorine since July 1, 1991.[32]

Standards for purity are fixed by federal and state law and regulation. There is a two-tier system, imposed by federal law and given effect in part by the state.[33] "Primary drinking water regulations" for public water systems govern contaminants judged to have a direct adverse effect on health. "Secondary drinking water regulations" for public water systems govern contaminants "that primarily affect the aesthetic qualities relating to the public acceptance of drinking water."[34] "Maximum contaminant levels" are fixed for both primary and secondary contaminants. In general, primary standards must be enforced; compliance with secondary standards is voluntary.

3.2.1 *'Hardness' Components.* Water which contains mineral salts that interfere with the action of soap is called "hard." Generally calcium and magnesium compounds of natural origin cause hardness. When hard water is heated, as in domestic water heaters, the salts may settle out as "lime" which clogs pipes and reduces heating efficiency. Albion's water is hard, although hardness is not a "contaminant" for which a standard has been set.[35] The Michigan Department of Public Health records from 1927 to 1976[36] show hardness ranging from 265 mg/*l* (milligrams per liter) to 425 mg/*l*. In 1980, Ayres et al reported hardness ranging from 306 to 325 mg/*l*.[37]

3.2.2 *Iron and Manganese.* Iron in solution gives water a metallic taste at rather low concentrations. The Michigan Department of Public Health analyses of water at city wellheads from 1927 to 1976[38] showed iron concentrations ranging from 0.05 mg/*l* to 2.7 mg/*l*, with the typical sample below 1.0 mg/*l*. Manganese ranged from none detected to 0.06 mg/*l*. Ayres, et al, reported iron ranging from 0.4 to

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[31] Ayres, Lewis, Norris & May, Inc. *City of Albion, Michigan/Municipal Water Plan.* Ann Arbor, 1980, p. 34; Jones & Henry, 1988, pp. 8 and 9.

[32] Section 4.1.3.

[33] The federal statute is Subchapter XII of the Public Health Service Law, found in Title 42 of the United States Code, beginning at Section 300f. The federal regulations are in Title 40 of the Code of Federal Regulations, in Parts 141 to 143. The state law is the Safe Drinking Water Act, Public Act No. 399 of 1977, beginning at Section 325.1003 of the Michigan Compiled Laws. Applicable state regulations are found in Part 22 of the Water Resources Commission rules, beginning with Michigan Administrative Code of 1979, at R 323.2201; the Division of Environmental Health groundwater quality control rules, beginning at R 325.1601, and Part 1 of the Health Services Administration rules, beginning at R 325.10102.

[34] 40 Code of Federal Regulations, §143.1.

[35] It has been called "very hard." Jones & Henry, 1988, p. 7.

[36] Reported in Ayres, et al, p. 36.

[37] P. 35.

[38] Reported in Ayres, et al, p. 36.

1.0 mg/*l* and manganese at 0.1 mg/*l* in 1980.[39] In the presence of air, the metals may oxidize and settle out, causing "red water," red or black staining, or sediment. Complaints suggest that Albionites consider the presence of iron and manganese the most serious deficiency in water quality. Iron and manganese are governed by secondary standards. The secondary maximum contaminant levels are fixed at 0.3 mg/*l* for iron and 0.05 mg/*l* for manganese.[40]

3.2.3 *Microorganisms.* The Michigan Department of Public Health requires that the city regularly[41] test the wells and distribution system for indications of harmful bacteria. Earlier studies have assumed that the presence of aerobic and anaerobic bacteria, including iron and sulfur bacteria, have contributed to unpleasant tastes and odors.[42,43] Primary standards for coliform or disease-causing organisms have not been violated in any sampling reported.[44,45] The water supply has been treated with chlorine since 1991.[46] Since the effectiveness of chlorine as a disinfectant is well established, the committee assumes that microbial contamination is not a concern.[47]

3.2.4 *Hydrogen Sulfide.* Hydrogen sulfide has been assumed to contribute to taste and odor problems.[48] In a 1980 state study, no hydrogen sulfide was detected in samples from either well field.[49] In 1988, hydrogen sulfide was detected in one of the Brownswood wells.[50] Jones & Henry note that sulfur bacteria can reduce sulfates to hydrogen sulfide,[51] but apparently no investigation of such bacteria has been made.

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[39] P. 35.

[40] 40 Code of Federal Regulations, §143.3.

[41] Federal regulation, the ultimate source of the requirement, calls for 10 samples a month for systems serving a population of 8,501 to 12,900 people. 40 Code of Federal Regulations, §141.21(2). Samples are taken weekly from taps at two or three widely spaced locations around the distribution system. To ensure the validity of the tests, the samples are usually taken directly by city personnel to the Michigan Department of Public Health testing laboratory at the state secondary complex in Lansing.

[42] Ayres, et al, p. 37, reporting results of a 1980 analysis by the Michigan Department of Public Health. "Iron bacteria usually develops [sic] in areas with little movement of water within the distribution system, so samples taken at the well field would not be likely to contain the bacteria."

[43] Jones & Henry, 1988, p. 8.

[44] Coliform bacteria are universally found in the human intestinal tract. Their presence in water does not necessarily mean that there are disease-causing organisms there, but indicates contamination from sewage or septic waste which may well include such organisms.

[45] Committee interview of city staff, November 1996.

[46] Section 4.1.3.

[47] But ensuring safe municipal water supplies remains a challenge. For a general treatment of the question, as well as of alleged hazards of disinfection by chlorination, see *The New York Times Magazine,* "Drinking Water Comes to A Boil/Episodes in Milwaukee, New York and elsewhere show America what must be done to turn the tap with confidence," Sept. 26, 1993, p. 42.

[48] Ayres, et al, p. 34.

[49] Reported in Ayres, et al, p. 37. "[H]ydrogen sulfide may be present only in trace minimal amounts."

[50] Jones & Henry, 1988, Table 5, p. 6.

[51] Jones & Henry (1988), p. 9.

3.2.5 *Volatile Organic Compounds.* In the spring of 1981, small amounts (2 parts per billion) of trichloroethylene (TCE), a degreasing solvent, were detected in wells in the Clark Street field[52]. Pumping from that field stopped June 8, 1981. After a lawsuit by the State of Michigan, a groundwater purging operation was undertaken by McGraw-Edison's successor, Cooper Industries, at the former McGraw-Edison Coolerator Division plant on N. Clark Street. In June 1982, the city resumed pumping some of its water from the Clark Street wells. The wells have regularly been tested for volatile organic compounds, including TCE, but none has been detected since 1983.[53] In November 1988, low concentrations of several organic chemicals were detected in the three wells in the Brownswood field,[54,55] and they were shut down. The amounts of chemicals measured were within primary standards. However, some substances were found for which no maximum contaminant levels had been set as of January 1991.[56] The Brownswood wells have not supplied water to the city system except on a standby basis since November 1988. The study committee finds no suggestion that very small amounts of volatile organic compounds have contributed to water quality complaints, although they represent the most serious threat to the municipal water supply.

3.2.5.1 *The Brownswood Aquifer Study.* A hydrogeologic investigation of the Brownswood Road well field area was conducted in the fall of 1992. An important purpose was to study the contamination of the well field by volatile organic compounds. There were concerns (including those advanced by this committee) that not enough was known about the contaminants to judge the adequacy of the treatment plant then proposed by the Albion city administration.[57] Hull & Associates, Inc., studied hydrogeological conditions in the area, drilled several test and monitoring wells, and conducted a 49-hour pumping test. The tentative findings are embodied in a draft report circulated in February 1993.[58] The report confirmed impressions that hydrogeologic conditions in the area are complex and highly variable. In places, the bedrock aquifer is "unconfined"; that is, it is exposed at the water table, and thus susceptible to relatively rapid contamination. The tests showed that pumping increased the flow of water in the aquifer toward the well field, especially from the east. Low concentrations of volatile organic compounds were detected in monitoring wells to the north and east. The consultants then modeled the flow of contaminants based on information about known soil and groundwater contamination to the north and east of the well field. They concluded that as plumes of contamination were drawn to the wells, concentrations of contaminants would stabilize in five to 15 years at levels that could be treated successfully. However, they predicted that within a few years, treatment would result in air emissions from the treatment plant that exceeded air quality standards. They suggested further analysis of contamination sources. They also

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[52] Rieger, William L., then City of Albion director of public works. Letter to committee member Lawrence D. Taylor, Oct. 4, 1991.

[53] Rieger letter, Oct. 4, 1991. See also footnote, Section 3.3.3.

[54] Hull & Associates. *Report of Long-Duration Pumping Tests at the Brownswood Well Field and the Water Works Well Field.* Toledo, 1988. Cited in Jones & Henry Engineers, Inc., *Water Treatment Plant/Basis of Design.* Toledo, 1991.

[55] See table in Appendix B.

[56] Jones & Henry, 1991, p. 6. The engineers stated, without further explanation or authority, "The MDPH [Michigan Department of Public Health] will not permit use of the Brownswood Well Field unless VOC treatment is provided." P. 7. Since the water has never violated primary contaminant standards, that statement seems questionable..

[57] Section 4.4.

[58] Hull & Associates, Inc., *Hydrogeologic Investigation for the Brownswood Well Field (Draft).* Toledo, Ohio, 1993. The information in this part is based on the draft report. A final report was never produced. The consultants had hoped to use information from well logs and monitoring wells on nearby private property for enhanced computer modeling of the aquifer. However, agreements on access to information could not be reached.

suggested that it might be in the city's best interest to develop a new municipal well field instead, with an "aggressive wellhead protection program."[59]

3.2.6 *Other Chemical Contaminants from Human Activity.* The only chemical contaminants caused by people which have been detected in Albion water are the volatile organic chemicals identified above. Others which can cause problems in public water supplies are nitrates, especially from agriculture, and heavy organic chemicals such as pesticides and PCBs.[60] None have been found in Albion's water.

3.2.7 *Radon Contamination.* The EPA has proposed a maximum contaminant level for radon in drinking water. Preliminary monitoring by the Michigan Department of Public Health showed water from the Clark Street wells had radon at amounts just below the proposed standard.[61]

3.3 *Known and Potential Sources of Contamination.* The sources of the volatile organic compounds found in the water at the Brownswood wells have not been identified. There are some known sites of hydrocarbon contamination in the general area of the wells. Other sites with hydrocarbon, heavy metal and other forms of pollution may threaten surface and ground water quality in the Albion area generally.[62] The study committee thinks these sites are particularly important:

3.3.1 *Underground Storage Tanks.* Buried fuel storage tanks in the Albion area may number in the hundreds. Not all tanks are regulated; those exempt include smaller farm and residential tanks. Regulated tanks are supposed to be registered, but it is assumed there are many unregistered and unknown tanks. The Michigan State Police fire marshal listed 66 registered tank sites (many with multiple tanks) in the Albion area in its 1993 list.[63] In 1991, the city staff's own list included 84 buried tanks in the city, identified through interviews with older citizens and some "educated guesswork."[64] Some of those are

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[59] Hull & Associates, p. viii.

[60] Polychlorinated biphenyls, until recently commonly used as cooling liquids in electric transformers.

[61] Fishbeck, et al. "Re: Proposed Radon Regulation." Kelley, William A., P.E. Letter to Ralph A. Lange, Albion city manager, Oct. 16, 1991.

[62] The Michigan Environmental Response Act, Public Act No. 307 of 1982, required among other things that the Department of Natural Resources annually compile a list of contaminated sites requiring a "response." The sites were scored according to a numerical assessment system. Listing made a site eligible for public financing of a cleanup. Sites in the Albion area on the April 1995 list for fiscal 1996 included the Sheridan-Albion Township landfill, with chromium, nickel, lead and cyanide (undergoing evaluation and interim response, with a "site assessment model" score which made it one of three Calhoun County sites on the state list of "highest-ranking" sites); Airco Rare and Speciality gases, with chromium and zinc (evaluation and interim response); Brooks Foundry, with methylene chloride, PCBs, PNAs and pesticides (evaluation and interim response); Brown Weld Service, with toluene soil contamination (inactive); Calhoun County Road Commission garage (evaluation and interim response); McGraw-Edison, with TCE (cleanup in "operation and maintenance" mode); Mid Michigan Metal Products, with cadmium, copper, lead, zinc, TCE, DCE, and PCE in groundwater and soil (inactive); and the Brownswood well field, with MTBE and dichlorodifluoromethane (evaluation and interim response). Several sites which had appeared on the 1990 list had been removed by 1995, and others had been removed to a separate list of leaking underground storage tank sites (see footnote, Section 3.3.1.).

[63] *Michigan UST-DMS Facility and Tank Data Listing by County*, Aug. 10, 1993, cited in Fishbeck et al, 1994, pp. 7-10. The list included sites from which tanks that had been removed (39 sites) as well as those where tanks were still in use.

[64] Interview with city staff.

known to have been removed since then. The fiscal year 1996 Act 307 list[65,66] included 26 leaking underground storage tank sites in the Albion area where cleanup actions had been taken or were underway. Leaking underground storage tanks are one of the main sources of hydrocarbon pollution of soil and groundwater.

3.3.2 *The Street Department Garage Site.*[67] Two underground fuel storage tanks were removed from the City of Albion's street department garage in September 1989. Monitoring wells were drilled after soil tests showed hydrocarbon contamination from leaks extended down to the water table, about 20 feet into the ground. "Free petroleum product" (gasoline) was found floating on the water table in wells near the northeast corner of the building (the old Albion Armory building at 1203 E. North St.) In February 1990, several hundred gallons of "petroleum product" was pumped from one of the monitoring wells. There is also evidence that soil had been contaminated by mineral spirits poured down a floor drain. Tests were made in the Clark Street well field in July 1990 to determine the likely effects of pumping on the contaminated aquifer. Those tests showed that while the bedrock aquifer (the sandstone formation from which the Clark Street wells draw water) is very porous, and the area influenced by pumping is large, the upper aquifer is not measurably affected by pumping from the lower sandstone.

Apparently the upper aquifer has remained adequately separated from the bedrock aquifer in the area of the Clark Street well field by an effective aquitard (such as a layer of clay or shale which liquids cannot readily penetrate). Two of the Clark Street wells, from which the city is now pumping all its water, are less than 200 feet from the site of the leaking tank. With the tanks and "free product" removed, further cleanup efforts will focus on a plume of contamination in the upper aquifer which appears to be moving slowly away from the well sites.[68]

3.3.3 *The Cooper Industries (McGraw-Edison) Site.*[69] McGraw-Edison Company closed its Sheridan Township plant on N. Clark Street in 1980. Investigation disclosed TCE contamination of the land and aquifers surrounding the former McGraw plant, less than half a mile from the Clark Street wells. Apparently it results from the use of spent solvents to control dust outside the plant. McGraw-Edison has been treating ground water from the bedrock aquifer by air-stripping since 1984 to purge it of TCE. Water from the shallow aquifer, originally drawn from eight wells about 25 feet deep, is treated by filtering it through activated charcoal. In 1990, Cooper Industries (then the successor to McGraw-Edison) received permission to use up to 680,000 gallons of treated deep-aquifer water a day to flush soils near the surface of TCE, and in 1991 installed 27 more shallow wells. In 1995, flushing of three of the four soil areas stopped because approved treatment levels had been reached. The fourth area continues to be treated, as does the deep aquifer. During 1996, Cooper Industries has pumped and treated about 2.8 million gallons a day from the bedrock aquifer and 200,000 gallons a day from the shallow aquifer. After treatment, all water not used for flushing soils is discharged to the Kalamazoo River through the Mingo Street drain under federal, state

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[65] See footnote, Section 3.3.

[66] *Michigan Sites of Environmental Contamination–Leaking Underground Storage Tanks (Vol. 2),* Michigan Department of Natural Resources, Underground Storage Tank Division, Lansing 1995 (for fiscal 1996).

[67] The content of this paragraph is based on a report by the city's environmental engineering firm. Hull & Associates, Inc. *Remedial Investigation Work Plan for the City of Albion Street Department, 1203 North Street.* Toledo, 1991. Insolvency of the state's underground storage tank cleanup program has slowed work across the state.

[68] In November 1996, a "work plan" for further cleanup was still in preparation. Indications were that the initial response work had been quite effective.

[69] Information in this part about the recent status of the remediation operation was taken from a letter to the committee from Richard H. Uber, manager, field operations, Cooper Industries, Houston, Texas, *Re: McGraw Edison Plant site,* Nov. 15, 1996.

and city permits. Progress of the purging operation is monitored at several places around the site, including a monitoring well between the plant site and the Clark Street wellfield. According to Cooper Industries,

> Over the history of the cleanup the TCE levels have continued to decrease as the cleanup progresses. Data collected from the monitoring well . . . between Clark Street well field and the McGraw Edison extraction well indicate that no TCE has been detected in this well since 1984.[70] Cooper also collects data regarding the depth of water in each aquifer, this data has verified that a hydraulic divide exists between the McGraw Edison well and the Clark Street well field, which restricts groundwater flow toward the Clark Street wells from the McGraw Edison site.[71]

As noted above, the Clark Street wells have produced almost all the city's water since November 1988.

3.3.4 *The Brooks Foundry, Inc., Site.*[72] Brooks Foundry, Inc., 1712 E. Michigan Ave., produced gray-iron castings at its plant from 1942 to February 1989. Used foundry sand[73] was deposited in the low area south of the facility. Foundry sand was also hauled from the site to a former gravel quarry along the railroad right-of-way about a half-mile northeast of the site. Process waste water was piped into two unlined lagoons south of the building in a foundry sand disposal area. The lagoons emptied into the Kalamazoo River near Newburg Road. The lagoon area is in the flood plain of the east branch of the Kalamazoo River. The river is not a source of drinking water, but people do use it for fishing, boating and other recreational activities. A large wetland surrounds the river where it flows past the site. In September 1987, the Technical Support Division of the Environmental Protection Agency (EPA) conducted an inspection. It revealed that hazardous wastes were being generated and improperly managed. In 1989, after the plant closed and the company was in bankruptcy, the Sheridan-Albion Township Fire Department and the Michigan Department of Natural Resources (DNR) made another inspection. It revealed hundreds of drums of ignitable paints, paint wastes, acids, oxidizers, PCBs, and petroleum products. An EPA technical assistance team completed an "emergency removal" at the facility in 1989. It removed 800 drums, 45 tons of contaminated soil, five underground storage tanks and three PCB-containing transformers. That initial cleanup of the site by the EPA took place at a cost of more than $1 million. The property was under the management of a court-appointed bankruptcy trustee from 1989 until 1994. Consultants hired by the trustee did other general clean-up in and around the foundry building before the trustee abandoned the property. There have been no further enforcement or clean-up actions at the site. The foundry property is reverting to the State of Michigan for unpaid taxes. In 1995, it was administratively divided into two parcels. They are the "upper" parcel, where the disused foundry building and several smaller buildings are, and the "lower" parcel, the site of the contaminated foundry sand[74] and lagoons. Investigations of the upper

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[70] The city's records show the last report in 1983. See footnote, Section 3.2.5.

[71] Uber letter to committee.

[72] This section is based generally on U. S. Environmental Protection Agency, "Superfund Fact Sheet, Brooks Foundry, Albion, Michigan," July 1989; on two reports prepared by the Michigan Department of Natural Resources, *Screening Site Inspection Report for Brooks Foundry/Albion, Michigan,* Lansing, 1992, and *Expanded Site Inspection Report for Brooks Foundry/Albion, Michigan,* Lansing, 1993, and on a memo to the committee from Cindy Fairbanks, Michigan Department of Environmental Quality/Environmental Response Division, Superfund Section, Nov. 14, 1996.

[73] See Section 3.3.10.

[74] Analysis of soil samples collected from the piled foundry sand and nearby monitoring wells detected the presence of anthracene, pyrene, chrysene, phenanthrene, fluoranthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(h,h,i)perylene, PCBs, aluminum, arsenic, barium, cadmium, chromium, copper, lead, magnesium, manganese, mercury and zinc. Michigan Department of Natural Resources Screening Site Inspection Report, 1992, and Expanded Site Inspection Report,

parcel found small amounts of contamination. The Michigan DEQ[75] and the EPA agree that it is a qualified candidate for "brownfield" redevelopment.[76]

The lower parcel, the "Brooks Foundry lagoons," has been nominated for the National Priorities List.[77] That would qualify it for remedial action and cleanup in the federal Superfund program. The shallow and Marshall sandstone aquifers are thought to be hydrogeologically interconnected in the area. Thus the deep aquifer is susceptible to contamination from the site. The east branch of the Kalamazoo River is immediately south of the site. It flows through an ancient drainage channel which was created by glacial runoff in the Wisconsin glacial age. Contaminants from the site have been measured in the nearby river.

3.3.5 *The Sheridan-Albion Township Landfill Site.*[78] A privately owned, state-permitted, 30-acre landfill served the City of Albion and the surrounding townships from June 1966[79] until 1981. It is about a half-mile east of Brooks Foundry on E. Erie Road at the east county line. It was managed as a "sanitary landfill," to control rodents and other nuisances. There was relatively little other management of materials and substances dumped there. After the landfill closed in 1981, a transfer station was operated immediately to the north until 1985. The site, one mile east of the city limits, is 1,000 feet west of Amberton Village, a residential subdivision in Parma Township, and 1,200 feet north of the east branch of the Kalamazoo River. It is less than 2 miles from the Clark Street well field.

In the early 1970s the landfill received approval from the Michigan DNR to accept sludges described as insoluble hydroxides and carbonates. Tests in 1984 and 1986 showed that the sludges contained high levels of chromium, cadmium, lead, nickel, chloride and cyanide. The deposits were estimated to be more than 6 feet thick and to occupy as much as 6,000 cubic yards. In 1986, 40 drums were found at the site. Many were leaking. They contained a variety of potentially flammable volatile organic compounds, oil and grease wastes.

1993, cited in Fairbanks memo..

[75] Responsibility for Michigan environmental programs was shifted in 1995 from the Department of Natural Resources to a new "Department of Environmental Quality" (DEQ). DEQ is a new "principal department" created administratively within the executive branch. Its director serves at the pleasure of the governor. Executive order No. 1995-18, July 31, 1995, effective October 1, 1995.

[76] A "brownfield" is a disused industrial property where environmental contamination may be an impediment to redevelopment. Any plan to reuse such a parcel must include investigation to determine if there is any contamination exists, and an evaluation of the feasibility of the proposed use, given the possible need to deal further with contamination. Public Act No. 71 of 1975 amended the state's Natural Resources and Environmental Protection Act (Chapter 324 of the Michigan Compiled Laws) with measures aimed at "restoring the economic value of sites of environmental contamination." A report to the legislature on their effectiveness is due before June 5, 1997, according to Section 20112a of the law.

[77] The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), known as Superfund, was enacted by Congress in 1980 to respond to hazardous waste problems that may pose a threat to the environment. The U. S. Environmental Protection Agency (EPA) administers the program. Removal actions are undertaken in cases of imminent danger to the public and the environment to bring a situation under control by stabilizing or stopping the release of hazardous substances. Remedial actions usually involve more extensive work to clean up a site or contain contaminants. The U. S. EPA considers a variety of factors in choosing remedial or removal action. In Michigan a Superfund site remediation involves the EPA, the Environmental Response Division of the Michigan Department of Environmental Quality (MDEQ), the Michigan Department of Public Health (MDPH), the Environmental Health Division of the Calhoun County Health Department, and numerous consulting firms and laboratories under contract with those agencies.

[78] This section is based generally on two reports prepared by W W Engineering and Science for the U.S. EPA, *Final Presumptive Risk Assessment of the Sheridan-Albion Township Landfill/Albion, Michigan,* and *Final Remedial Investigation Report of the Sheridan-Albion Township Landfill/Albion, Michigan,* both 1994, and on a memorandum to the committee, "Project Update--November 1996," from Leah Evison, U.S. Environmental Protection Agency, Chicago.

[79] *Albion Evening Recorder.* "Old City Waste Yard Closing This Evening." June 9, 1966.

The site was designated a Superfund site by the EPA in 1989. The Michigan DNR fenced part of the site to limit public access. A remedial investigation was made in 1992 and 1993.[80] Exploratory excavations and 31 monitoring wells were used to assess the nature and scope of hazardous materials. A plume of contaminants was found, moving slowly to the southwest from the site in the shallow aquifer, and extending about 600 feet horizontally. It contained numerous organic and inorganic contaminants at low levels. Those included, in one well, arsenic in excess of primary contaminant standards. Arsenic occurs naturally in the Marshall sandstone. In this case, acidic leachates from the landfill released it from chemical bonds in the rock and permitted it to migrate in ground water.

Meanwhile, the EPA was trying to identify the parties responsible for the contamination and cleanup. The landfill served the city and surrounding townships, and most residents, businesses and industries in the area are presumed to have sent materials to it. However, specific information about the types of wastes disposed of by various users is scarce and the EPA has been able to identify few "potentially responsible parties." In October 1995 the EPA issued a "unilateral administrative order" to Cooper Industries, Corning, Inc., Decker Manufacturing Corp. and the City of Albion. It required them to design and carry out a cleanup of the site. Among them, only the City of Albion has said it does not intend to comply.[81] Cooper Industries and Corning, Inc., have have hired Woodard-Clyde Consultants, Livonia, to design the cleanup and construction plan. "Pre-design" studies were done in late summer 1996.[82] The schedule calls for preliminary design work to be completed in January 1997 and for the final design to be approved in June 1997. Work at the site is to begin in July 1997, and completion is scheduled for early 1998. The cleanup plan, on which the design will be based, was selected by EPA in 1995.[83] It calls for the removal of about 200 drums of waste still in the east-central part of the landfill. The site will be graded and some material may be moved in from the edges to consolidate the waste. The entire site will then be covered with 12 inches of sand to aid in gas collection. That will be covered with a flexible membrane liner to stop infiltration of water into the waste. The liner in turn will be covered with 18 inches of soil, six inches of sand for drainage, and six inches of topsoil. The area will then be planted to native species.[84] Gases generated by decomposing waste will be collected and vented.[85] The cleanup plan also calls for monitoring of groundwater. Residential wells close to the landfill site[86] and the Amberton Village wells will be tested

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[80] W W Engineering and Science, *Final Remedial Investigation Report of the Albion-Sheridan Township Landfill/Albion, Michigan.* Prepared for U.S. EPA, Chicago, 1994 (two volumes).

[81] For a number of years of the landfill's operation, the City of Albion contracted for its availability as a municipal waste site, and there is a dispute now between the city and EPA as to whether the city was "operator" of the site.

[82] Including the installation of more monitoring wells (two of which are readily visible between E. Erie Road and the Conrail mainline just west of the site) collecting groundwater samples, identifying the boundaries of the waste, evaluating gas emissions, and studying revegetation options. A detailed report is to be published in December 1996.

[83] In reaching the decision, EPA held public information meetings and accepted comment on its proposals, which were summarized in *Proposed Plan/Albion-Sheridan Township Landfill Superfund Site*, EPA, Chicago, 1994. The plan was introduced at the beginning of the comment period at a public meeting at the Albion Public Library October 5, 1994. See *Selected Remedial Alternatives for the Albion-Sheridan Township Landfill Site*, EPA, 1995, a copy of which is available at the library.

[84] Preliminary work included a study of revegetation options. It was concluded that the benefits of using native species (improving soil quality, reduced erosion, enhancement of native plant communities, preservation of native plant gene pools and less need for herbicides and mowing) outweigh the lower initial cost of planting turfgrass. Evison memo.

[85] Computer modeling was used to predict the volume of gas likely to be generated, and to evaluate the risk to those living in the area. It was determined that the gases will meet air standards without treatment. Evison memo.

[86] "[N]o site-related contaminants were detected in any residential wells during previous sampling." Evison memo.

quarterly.[87] Other wells will be tested annually. The plan requires that either recorded restrictions or local ordinances be used to prohibit the drilling of new wells close to the landfill. If the area of arsenic-contaminated groundwater does not decrease in five years, treatment will be required.

3.3.6 *The Cooper Street-Dean Drive (McIntosh Park) Waste Yard Site.* The city opened a waste yard on the northwest side of town about 1952. It was closed June 9, 1966, because it was filled to capacity.[88] McIntosh Park was built over the center of the site; neighborhoods on Dean Drive and Hoaglin Drive roughly define the perimeter. The site is about a mile from the Brownswood wellfield. A monitoring well was installed in 1992 in connection with the Brownswood wellfield study.[89] The well log noted particles of greyish-brown broken glass and occasional pieces of rubber and metal at depths between 5 feet and 17½ feet.[90] Analysis of a sample from the well showed very small amounts of three organic compounds above the detection limit.[91] The Michigan DEQ recently requested monitoring data from the city.

3.3.7 *The Harrington School Dump Site.* The city dump before 1952 was east of Clark Street and north of E. Erie Road. Harrington Elementary School (opened 1957) was built on the site, which is less than a mile from the Clark Street well field. The Albion Public Schools later constructed a bus parking lot and servicing area at the southeast corner of the site. In early August 1991, a 12,000-gallon gasoline tank and a 6,000-gallon diesel fuel tank were removed because they were leaking.[92] After extensive excavation of contaminated soil, which included digging beneath E. Erie Road, the site was backfilled in mid-October 1991.

3.3.8 *Old Dump at W. Erie Road and 25½ Mile Road.* The committee has consistently heard reports from long-time residents of a refuse dump in use decades ago--possibly after the Harrington School site[93] and before the McIntosh site[94]--just east of 25½ Mile Road, and north of W. Erie Road. No documented evidence about the dump has been found.

3.3.9 *The Hayes-Albion Corp. Site.* A leaking underground storage tank site on the grounds of Hayes-Albion Corp. was assumed by Hull & Associates[95] to be a source of contaminants

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[87] In 1991, two wells in the nearby Amberton Village subdivision, which draw water from the Marshall sandstone, had shown no detectable contaminants. Those wells are cased to a depth of 95 feet. A short distance to the west, in the Orchard Knoll area, two wells had been found contaminated with dichloroethane and trichloroethane. Michigan Department of Natural Resources. *Michigan Sites of Environmental Contamination/Priority Lists/Act 307.* February 1990 for Fiscal Year 1991. Both source of contamination and point of release were listed as "unknown." In 1991 and 1992, the City of Albion extended water mains east to provide service to eight residences and a church in the affected area, on E. Michigan Avenue and Orchard Knoll in Sheridan Township, all at state expense. *1992 Water Department Annual Report*, p. 46.

[88] *Recorder*, June 9, 1966.

[89] Section 3.2.5.1.

[90] Hull & Associates, 1993, Appendix A, log of well No. RW-5.

[91] 1.55 micrograms/*l* of vinyl chloride; 7.36 micrograms/*l* of tetrachloroethene, and 2.39 micrograms/*l* of cis-1,2-Dicholoroethene.

[92] *Albion Recorder.* "School Board appoints Dobbert superintendent." Sept. 4, 1991, p. 1.

[93] See Section 3.3.7.

[94] See Section 3.3.6.

[95] Hull & Associates, 1993, pp.82, 83.

significant for the Brownswood Road field. It relied on previous assessments and monitoring well test results. Those included benzene, toluene, ethylbenzene and total xylene concentrations at 55,000, 90,000, 5,000 and 17,000 parts per billion, respectively.[96] Those results were thought particularly significant because the substances were reported present in the bedrock. Reportedly, after soil removal, the Hayes-Albion site was capped.

3.3.10 *Foundry Sand Landfills.* Foundries have been a part of Albion's industrial history for a century, and have generated unnumbered tons of spent foundry sand from molds. Much of it has been used for fill and buried at numerous sites in and around the city. The sand, containing various binding agents and blackened from heat and the powdered coal which is sometimes a component, is generally inert. However, trace amounts of heavy metals and hydrocarbons from the heating of the coal are sometimes present. There are undocumented reports that materials other than foundry sand have been buried with it.

3.3.11 *Union Steel Products Co. Plant 4.* A known leaking underground storage tank site at the Union Steel Products Co. plant at Brownswood Road and N. Albion Street was considered a significant likely source of groundwater contamination by Hull & Associates in its 1993 study. It noted previous assessment results of 18,000 parts per billion for benzene, 25,000 p.p.b. for toluene, 1,100 for ethylbenzene and 9,300 for total xylenes.[97]

3.3.12 *Oilfield Production and Disposal Activities.* Albion sits atop the largest single deposit of petroleum in Michigan, the Albion-Scipio Trend. Developed beginning in 1956, the deposit stretches from northern Hillsdale County to just northwest of Albion. Wells were drilled at 20-acre intervals over the narrow field. Oil production results in spills, disposal (proper and improper) of residues and waste materials. Brine, sometimes in large amounts, is often produced with oil and must be disposed of. Accidents occur. In November 1968, the Midlam No. 1 gas well in Lee Township blew out. Attempts to control the high-pressure flow of natural gas caused it to migrate through the Marshall sandstone, displacing water and causing geysers and sinkholes over a broad area. A house was destroyed by an explosion in Marshall Township.[98] Although after nearly 40 years of production many Albion-Scipio wells have been plugged and abandoned, the sites remain a concern. Oil drilling, production and environmental activities are regulated by the Geological Survey Division, now part of the DEQ. Fishbeck, et al, reported interviewing DEQ personnel about possible brine contamination of the bedrock aquifer in its alternate wellfield investigation. It learned only that

> Some soil sampling at individual well heads has been completed; however, no groundwater samples have been collected to determine whether groundwater contamination has occurred.[99]

3.3.13 *Natural Sources of Hydrocarbon Contamination.* Petroleum[100] occurs here for the most part at depths from the surface of more than 4,000 feet. However, the possibility of natural seepages

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[96] Hull & Associates, 1993, p. 83.

[97] Hull & Associates, 1993, p. 82.

[98] *Albion Evening Recorder.* "Geysers, Bubbling Gas Erupt S.W. of Marshall." Nov. 29, 1968, p. 1.

[99] Fishbeck, et al, 1996, pp. 10, 11.

[100] See Section 3.3.12.

into water sources remains. Oil seeps were noted soon after the settlement of Albion.[101]

3.4 *Effects of Distribution System on Water Quality.* The city's water distribution includes 59.28 miles of water main,[102] made of cast iron and ductile iron, and a 500,000-gallon elevated storage tank. The water mains are laid in a grid which corresponds roughly to the street grid. The presence of fire hydrants[103] is a clue to the locations of mains,[104] which are buried below frost depth.

3.4.1 *Storage Tank.* The elevated storage tank ("water tower") serves three purposes: To provide an even flow of water under pressure despite variations in demand and supply,[105] to provide an emergency supply of water under pressure in the event of power or pump failure or other emergency, and to permit economical operation of pumps.[106] The tank is not thought to affect water quality.

3.4.2 *Water Main System.* Poor circulation through the grid of mains has been blamed for some of the city's water quality problems.[107] Dead-end mains[108] and areas of sluggish movement may have

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[101] The story was printed and reprinted around the country; this version is from the April 2, 1864, *Jackson Union-Herald*, by way of the *Louisville Journal* and the *Detroit Tribune*: "The circumstances connected with the Albion 'discovery' are worthy of repetition, and we trust that farmers and others will remember them; and whenever they find their wells having a funny taste, or see something greasy floating on their brooks, they will do well to recollected that 'striking ile' is having 'fortune thrust upon them.' Some twenty-two years ago [1842], says the *Detroit Tribune*, Daniel Compton, who was employed by J. Crowell, of Albion, in sinking a tail race for grist mill, discovered a black oily substance oozing from the sand rock [sandstone?] several feet below the surface of the ground. Mr. Crowell's attention was called to the fact, but he thought the black looking liquid was valueless.--Mr. Compton and his comrade gathered two pailfuls of the crude oil and used it in lamps, and it burned freely.--But the water was let into the race, and the matter was forgotten." Frank Passic, former curator of the Albion Historical Society's Gardner House Museum, identified the location of that discovery as the present Market Place, in the central business district.

[102] *1992 Water Department Annual Report*, p. 46. That is the last accurate number available; the extent of mains is now greater. Subsequent construction has included a main along the west city limits from Erie Street across the river to Brownswood Road in 1993, and new construction in the industrial park expansion area in the summer of 1996.

[103] There were 500 of them, 26 outside the city limits, as of 1992. *1992 Water Department Annual Report*, p. 46.

[104] Hydrants provide further information about the flow of water. The cap colors are coded to show the capacity of the hydrants. Green caps indicate a flow of 1,000 gallons a minute or more; orange 500 gallons to 1,000 gallons, and red less than 500 gallons.

[105] The tank was taken out of service in the fall of 1991 for maintenance, including interior cleaning and painting. In describing the work the *Albion Recorder* reported, "Because Albion has only one water storage tank, [then-Public Works Director William] Rieger said all of the city's water pumps will have to be monitored constantly while the pump [sic--tank?] is shut down to have the interior painted." *Albion Recorder*. "City's name might be added to tank." Aug. 21, 1991, p. 1. Apparently by coincidence, the same issue reported under the heading "40 years ago--1951": "Water pressure was varying sharply in the city due to the operation of pumps by employees by hand, while the Crowell park standpipe was empty and being repainted. Safety valves on water tanks in some homes were reported springing leaks." P. 4. Painting of the exterior--which did add the city's name for the first time--was deferred until the spring of 1992 because of early cold weather. *Albion Recorder*, "Repainting of tank put on hold." Sept. 27, 1991.

[106] In its 1980 water plan, Ayres, Lewis, Norris & May, Inc., estimated the city could save $2,000.00 annually in power costs by permitting the tank to operate over a 10- to 12-foot range in depth, rather than the four-foot range then in use. The city has elected to keep the water level higher, even at the cost of some efficiency, to ensure constant pressure and an adequate emergency supply. Interview with city staff.

[107] Jones & Henry, 1988, pp. 7, 8.

[108] About 1978, the city identified 25 dead-end water mains. About six of them had been eliminated by 1991 by the construction of new connections to complete loops. No construction to eliminate dead-ends has taken place since 1991. Some of the remaining dead-ends are on cul de sacs, and some mains end at the city limits or undeveloped areas, and it would not be practical to loop them. Interview with city staff.

had iron bacteria.[109] Iron and manganese compounds are more likely to accumulate there. The capacity of the water-main grid is estimated at more than 900,000 gallons. Assuming a uniform flow, the contents of the mains would be replaced about twice in an average day. Flow is certainly not uniform, although no study has been made of turnover in the water main system. Generally circulation is thought to be worst in the southwest part of town, since both wellfields and all large water users are on the north side. Although the proposed new wellfield is southwest of town, its production would be piped directly to the treatment plant site at Brownswood Road. Thus the circulation pattern would probably shift mainly at the city's north end. The new main constructed in 1993 from Brownswood Road beneath the river to Erie Street at Finley Drive should improve flow to the southwest part of town. Most complaints come from customers south of Irwin Avenue.[110] In particular, taste and odor problems are blamed on the water main system, although there seems to have been no thorough study of those problems as such. Dissolved iron and manganese are invisible in water newly pumped from the ground. Staining and sediments occur when air mixes with the water, causing those minerals to oxidize (in effect, to rust), and to come out of solution. The resulting sediments appear at the tap. They may also accumulate in mains until changes in flow rates and direction loosen them, causing turbidity, or discoloration, of water.[111]

4 Treatment.

4.1 *Present Treatment.* Albion treats its water by injecting three substances at the pumps: Fluoride, phosphate, and chlorine.

4.1.1 *Fluoridation.* Albion water has been fluoridated since January 24, 1966, by the addition of 1 part per million of fluoride. A 25% solution of hydrofluosilicic acid is injected at the pumps.[112] Fluoridation is not intended to affect water quality. It is a public health measure, to prevent tooth decay.[113]

4.1.2 *Phosphate Treatment.* The city's Department of Public Works recommended phosphate treatment for years. It was presented as a practical and relatively inexpensive solution to the city's water problems, and at the very least as a first step.[114] Albion began adding polyphosphate to its water July 1, 1991. The powdered chemical is mixed with water, then injected at each Clark Street pump at 2 to 2.5 parts per million.[115] Its purpose is to keep iron and manganese in suspension to reduce "rusty" water and staining. It would be discontinued if the proposed iron- and manganese-removal plant is built.

4.1.3 *Chlorination.* Albion began chlorinating its water July 1, 1991, as an adjunct to the

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[109] See Sections 3.2.3, 4.3.3.

[110] Interview with city staff.

[111] Jones & Henry, 1988, p. 9.

[112] *1992 Water Department Annual Report*, pp. 40-41.

[113] Fluoridation is a common treatment of municipal water, and is widely recognized as effective in preventing tooth decay. As far as can be determined, no study has been made of the public health effects of 30 years of fluoridation in Albion.

[114] Rieger, W. L., director of public works. "Re: Water Treatment." Memorandum to George Kolb, city manager, May 17, 1983; "Re: Water Treatment." Memorandum to Ralph Lange, city manager, Aug. 22, 1989.

[115] Interview with city staff.

addition of polyphosphate to control iron.[116] A 10% solution of chlorine in sodium hypochlorite--in effect, strong bleach--is injected at each pump in the Clark Street field at 1.5 to 2 parts per million.[117] Chlorine destroys bacteria in the water and in the distribution system.

4.2 *Limitations of Present Treatment.* Phosphate treatment does not remove iron and manganese. Rather, it prevents those minerals from coming out of solution. The method is most useful "where the municipal water is not treated by filtration, and the iron and manganese concentrations are less than 1.0 mg/*l*.[118] The reliability of this method is generally quite low and, therefore, its use is very limited."[119] Jones & Henry also criticized the "phosphate sequestering" method in its 1988 study.[120] When water is heated, the phosphates lose their sequestering properties and allow the iron and manganese to come out of solution.

4.3 *Technologies for Further Treatment.*

4.3.1 *Treatment to Remove Iron, Manganese.* Phosphate treatment may stabilize minerals, but it does not remove them. Iron and manganese can be removed from water by two methods: (1) ion exchange (usually restricted to individual water supplies with low concentrations of the minerals), and (2) aeration (usually accompanied by some chemical treatment) and filtration.[121] The Fishbeck, et al, proposal described the aeration and filtration method:

> . . . [I]ron and manganese can also be conveniently removed from groundwater. This would involve oxidation of the metals to insoluble forms followed by filtration of the resulting solids. Aeration alone, followed by 20 minutes detention time will effectively oxidize the soluble iron. However, oxidation of manganese in a reasonable time generally requires stronger chemical treatment using potassium permanganate. Chlorine may also assist in manganese oxidation.
>
> Following oxidation, the ferric iron and quadrivalent manganese precipitate as finely divided particles which must be physically separated from the water by filtration.[122]

The treatment plant to be built in conjunction with the development of a new wellfield would use aeration and filtration.

4.3.2 *Treatment to Remove Hardness.*[123] Central water softening is possible using either an ion-exchange or a chemical precipitation ("lime-soda ash") process. The ion-exchange, or brine-regeneration,

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[116] See Section 4.1.2.

[117] Interview with city staff.

[118] The chemical analysis upon which Ayres, et al, relied showed iron concentrations ranging from 0.2 mg/*l* to 5.3 mg/*l*. Manganese apparently was tested for only at one location, in the Brownswood field, and the concentration there was 0.1 mg/*l*. Ayres, et al, Table VI-I, p. 35.

[119] Ayres, et al, p. 40.

[120] Jones & Henry, 1988, pp. 11, 12.

[121] Ayres, et al, p. 39; Jones & Henry, 1991, executive summary; Fishbeck, Thompson, Carr & Huber. *Water Treatment Feasibility Study of City of Albion Brownswood Well Field.* Ada, Michigan, 1991, p. 7.

[122] P. 7.

[123] See, generally, Ayres, et al, pp. 41-42; Jones & Henry, 1988, pp. 12-13.

process is common in home water softeners. It substitutes sodium ions, which do not cause hardness, for calcium and magnesium ions, which do. The ion-exchange method is considered suitable and economical for smaller municipal plants. However, there are concerns about waste disposal. Increased concentrations of sodium in the treated water may cause problems for people on low-sodium diets.

The lime-soda ash process removes iron and manganese as well as hardness. It would eliminate the need for home water softeners.[124] It produces finished water of good quality, but is expensive to build and operate and is not under serious consideration in Albion.

4.3.3 *Treatment for Taste, Odor Problems.* Iron and manganese in small amounts impart a metallic, astringent or medicinal taste to water.[125] Microorganisms in the distribution system, in particular iron and sulfur bacteria, can cause "earthy" or "rotten egg" odors and tastes. Iron and manganese removal, described above and now proposed by the city, would eliminate the metallic taste of dissolved minerals. The disinfection begun in July 1991 is thought to have ameliorated the other objectionable tastes and odors. After five years of polyphosphate treatment and chlorination, the city water department has noted a decrease in the number of complaints about color and taste. However, that has been offset to some extent by complaints about the distinctive taste and odor of chlorine.[126]

4.3.4 *Treatment for Chemical Contaminants.* The organic chemical contaminants so far found in Albion's water are all volatile; that is, they readily evaporate. The favored means of removing such chemicals is "packed tower aeration," or "air stripping." In that process air is forced by powerful blowers through a column of water in a cylindrical tower-like structure.[127] The resulting contact with air effectively "strips" away the chemicals by evaporation. The process becomes more complicated and expensive if the concentration of chemicals in the water is so high that the evaporated chemicals, or "off-gases," may not be released into the atmosphere without violating air emission standards.[128] If that is the case, the chemicals must be trapped in some way, typically by carbon adsorption.[129] The process is also related to treatment for iron and manganese. The water's contact with air which "strips" the chemicals out also oxidizes those dissolved substances, especially the iron. Further treatment and filtering is used to remove the resulting solids. This technology is the basis for the treatment plant which was proposed for construction by the City of Albion in 1991.

4.3.5 *Scope of Treatment--Centralized v Decentralized.*

4.3.5.1 *Central Treatment.* The advantages of treating water centrally are

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[124] Rieger, W. L., then director of public works. "Re: Water Treatment." Memorandum to Ralph Lange, city manager, Aug. 22, 1989, pp. 1 and 2.

[125] Ayres, et al, p. 39.

[126] Interview with city staff, 1996.

[127] See generally Fishbeck et al. This is the technology in use in the McGraw-Edison groundwater purging operation. See Section 3.3.3. For a highly technical treatment, see also Hand, David W., John C. Crittenden, and Joseph L. Gehin, "Design and Evaluation of an Air-Stripping Tower for Removing VOCs from Groundwater." *Journal American Water Works Association*, Vol. 78, No. 9 (1986), pp. 87-97.

[128] Fishbeck et al, p. 6.

[129] Carbon adsorption treatment may also be required if non-volatile organic chemicals are present; air stripping is ineffective to remove them from water.

economies of scale,[130] the allocation of capital, operating and maintenance costs to all water users, and the uniform improvement of a community resource. There are obstacles to central treatment in Albion, however. The city's two existing well fields are about 2 miles apart, in the northeast corner of town and on the west central side.[131] The proposed development of a new wellfield would further complicate the issue, although the city's plan[132] calls for a treatment plant to be built near the Brownswood Road wellfield for convenience of staffing and connection to the distribution grid. Water produced from the Clark Street field in the future, such as at peaks of production, or in emergencies, would enter the distribution system treated with fluoride, chlorine and polyphosphate. It would not be treated to remove iron and manganese.

4.3.5.2 *Decentralized Treatment.* Much Albion water is already treated before consumption. It is difficult to calculate how much.[133] Many Albion residences have water softeners. Some have iron filters, or use iron-removing chemicals in water softeners. Some residential users have filtering devices at the tap.[134] Some industries and other large users treat water for their particular needs.[135] The advantages of decentralized treatment are that users may select the treatment they desire, if any,[136] avoid the cost of treatment, and selectively treat water within households.[137] It might be less expensive to remove some chemical contaminants by carbon filters on drinking water taps than by building a central air-stripping facility.[138]

4.3.6 *Treatment and Industrial Uses.* The study committee has not identified any industrial user for which the proposed city treatment is economically advantageous. Hayes-Albion Corporation, long the single largest user, has announced its support for the city's plan, however.[139]

4.3.6.1 *Industrial Uses Not Requiring Treatment.* Albion's largest industrial

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[130] But it is debatable whether it is economical to treat the entire water supply, including that used for industrial cooling, lawn watering, and the like.

[131] Ayres, et al, assumed in 1980 that the city would routinely require the production of two wellfields, and suggested that a raw-water main would have to be constructed between Clark Street and Brownswood Road. Apparently the cost was not carefully studied, but the cost then for a 2-mile 16-inch main was estimated at $700,000 to $1 million. P. 48

[132] See Section 5.2.

[133] There are no known statistics about home water treatment.

[134] Installation of such filters is a frequent request of Albion College students. Kolmodin interview.

[135] Albion College, for example, gives special treatment to water for its central steam heating plant, as well as operating water softeners at numerous locations in its buildings. Kolmodin interview.

[136] The study committee is aware that some Albion water users are quite satisfied with the water as it has been for years. There is no way to know how many.

[137] It is apparently a common practice, for example, for domestic water systems to supply unsoftened water to the cold-water tap in a kitchen and outdoor hydrants, and softened water elsewhere.

[138] But water-quality laws would certainly not permit that approach if chemical contaminants exceeded primary standards; there would be no way to ensure that filters were installed and kept functioning.

[139] " '. . . Harvard, Hayes-Albion, is in full support of the city manager and council's plan to develop a new municipal water source that will have a wellhead protection attached to it,' said Terry Baker, engineering manager for Hayes-Albion. . . . [W]e're willing to support this proposal because we realized it's something that has to be done." *Albion Recorder,* "Hayes-Albion announced support of water project," Oct. 4, 1996.

users, which use water mainly for cooling, have made it clear they have no need for centrally treated water from the city. The economies of recycling process water have already caused significant and continuing declines in industrial water use.[140]

4.3.6.2 *Industrial Uses Requiring Treatment.* Industrial users which do require treated water, on the other hand, may have particular requirements which require them to treat individually regardless of what treatment the city might undertake.

4.3.6.3 *Disadvantages of Selective Treatment.* Separate treated and untreated water supplies would require expensive construction of parallel distribution systems, including separate water towers to control pressure. Even industries favoring untreated water require potable water supplies throughout their plants for the personal needs of employees.

4.4 *Specific Proposal for Treatment: The 1991 Fishbeck, et al, Proposal.* The City of Albion's city managers and staff have been studying the water issue since about 1980. In 1991, the administration recommended to the City Council[141] that the city take the first steps to develop a water treatment plant. The proposal was to use air-stripping technology to remove contaminants, and incidentally, iron and manganese. A pilot test of air-stripping methods was done at the Brownswood field.[142] The facility, then estimated to cost $4.2 million,[143,144,145] was not built. The annual operating cost was estimated at $193,000.00 in 1991.[146]

4.5 *Treatment in Nearby Communities.* Marshall has operated an iron removal plant for 31 years, using six filters to treat water from its four wells, all in the city limits. Despite that treatment, the main complaints received by water department personnel in Marshall concern rusty and black water, odors, and disagreeable taste, and the department spends many man-hours and thousands of dollars a year in maintenance in response to complaints. In 1991 the city contemplated replacing its aging filtering plant with a lime-soda ash plant at a cost then estimated at $5.3 million. Another water tower and extensive water-main replacement were also proposed.[147] However, Marshall decided to replace the old filters with four larger ones at a cost of $550,000. It has done extensive work to eliminate dead-end mains and installing new and larger mains.[148]

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[140] See Section 2.4.

[141] Lange, Ralph A. and staff, "Memorandum #91-32" to Mayor Jack H. McClure and members of City Council, March 8, 1991.

[142] The test confirmed the feasibility of treatment of substances detected in the water, but did not undertake to determine the sources or scope of contamination. Tentative results were cited by the city, but apparently no report was published.

[143] Fishbeck, et al. "Re: Proposed Water Treatment Plant/Response to Questions Raised on February 20, 1991." Letter from William A. Kelley, P.E., and Thomas C. Gavin, P.E., to Ralph A. Lange, city manager, Feb. 26, 1991.

[144] Compared to Jones & Henry's estimate of $4.6 million. Jones & Henry, 1991, p. 14. Fishbeck estimated the cost in August 1996 at $6 to $6.6 million.

[145] Including service building, laboratory, workshop and garage areas. The location would have been near the city's wastewater treatment plant, where many of the required facilities are already available. The cost of the plant could be reduced by omitting those facilities.

[146] Fishbeck, et al, Feb. 26, 1991, letter.

[147] *The Marshall Chronicle.* "Residents want council to decide about water." Sept. 5, 1991, p. 1.

[148] Interview with Fred Pratley, Marshall water superintendent, by committee member Sue Marcos Nov. 18, 1996.

Battle Creek began studying the feasibility of iron and manganese removal in 1991. The city commission in July 1996 approved construction of a $10 million, 30 million-gallon treatment plant to remove iron, manganese, and radon. It is scheduled to be completed in December 1997. The radon removal capability was included in anticipation of a new primary standard, still only proposed.[149] The city expects to continue to add smaller amounts of phosphates to control corrosion and acidity.[150]

Coldwater completed construction of an iron- and manganese-removal plant in June 1996. It cost $6.7 million, including new offices, a garage, stockroom and service vehicle. Coldwater's rate schedule[151] in effect amounts to a flat rate for residential users, whose use has not been metered. There was some opposition from residents who feared the project would require metering. That did not happen, although residential rates have doubled. Industrial and commercial customers were also concerned about costs, although no significant change in their use has been noted. Coldwater water superintendent Tom Spitzner reported that the system is removing 96% to 98% of iron and manganese, and that complaints have virtually ended.[152]

5 Alternatives to Treatment.

As an alternative to treating water from existing wells, or as a backup source in the event of new contamination or breakdown of treatment, new sources of municipal water could be developed. That is now the City of Albion's primary strategy for providing a safe, secure water supply.[153,154]

5.1 *Development of New Well Fields.*

5.1.1 *Availability of Uncontaminated Aquifers.* There are large areas of relatively undeveloped land within a few miles of Albion. Ample sources of uncontaminated groundwater, particularly from bedrock aquifers which are relatively unsusceptible to pollution from surface sources,[155] are likely to be

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[149] See Section 3.2.7.

[150] Interview with David Rich at Battle Creek's Verona pumping station by committee member Sue Marcos Nov. 18, 1996.

[151] See Appendix C.

[152] Interview with Tom Spitzner by committee member Sue Marcos Nov. 19, 1996.

[153] Action of Albion City Council September 3, 1996. See Section 5.2.

[154] The Albion City Council first agreed to explore the option of an alternate wellfield at a work session February 1, 1993. *Albion Recorder*, "City of Albion is looking at new well field." Feb. 2, 1993, p. 1.

[155] Susceptibility to pollution varies because the surrounding materials vary. "As a confined [bounded above and below by impermeable clays or rocks] aquifer this formation [the Marshall sandstone] is reasonably well protected from surface contamination; however, as a semiconfined aquifer [bounded by materials that transmit water slowly] it is obviously less well protected from surface contamination." Moser, James E. and Richard N. Passero. *Geology and Aquifers in Calhoun County, Michigan.* Kalamazoo (Western Michigan University), 1990, p. 30.

available.[156,157] The integrity of such aquifers may be protected by controlling surface uses through zoning and other land-use regulation.[158] However, pumping large amounts of water may draw contaminants toward the wellheads from sources within the wells' zone of contribution.[159,160] There are also thought to be sources of water in shallower aquifers,[161] and there are "buried valleys" of glacial gravels which store larger quantities of water.[162] Such aquifers are more susceptible to contamination from human activities, including waste disposal, agriculture and surface pollution, than are the deeper aquifers. No municipalities in the Albion area are known to draw water other than from bedrock aquifers.[163]

5.1.2 *Natural Chemical Characteristics.* Any study of a new water source would include an evaluation of the natural chemical attributes of the water available there. In this area, alternative sources of water uncontaminated by human beings are still likely to contain iron, manganese, and minerals causing hardness.[164,165] Those are the water components thought by the study committee to give rise to most water-quality complaints. Treatment would probably still be needed to provide satisfactory finished water. A preliminary study of the kind described above would include a review of what is known about the water chemistry of the area. The Michigan Groundwater Survey for Calhoun County published extensive

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[156] 234 private wells in all 20 townships in Calhoun County were studied by the Michigan Groundwater Survey, all in areas removed from waste disposal sites and other known sources of groundwater contamination. Of them, 63 were sampled for volatile organic compounds, and 15 of those for chlorinated pesticides, acid herbicides and nitrogen herbicides and pesticides. "No quantifiable amounts of any of these organic substances were found in any water sample from Calhoun County." Michigan Groundwater Survey. *Groundwater Chemistry/Statistical Summaries for Calhoun County, Michigan.* Kalamazoo, 1990, p. 32.

[157] An impression borne out by the preliminary pumping test at the selected site. See Section 5.2.3.1.

[158] See the discussion in Section 5.1.3 of wellhead protection standards.

[159] A pumping well draws down the water table in a pattern described as a "cone of depression." Projecting the perimeter of the cone of depression to the surface defines the "zone of influence" of the well. The area which recharges the zone of influence is called the "zone of contribution." It is sometimes also called the "zone of capture".

[160] "Based on area geology, a study of the Brownswood Well Field, and the opinions of the Michigan Department of Public Health, it is believed to be impossible to locate a contamination-free well field that could be guaranteed to remain contamination-free in the future." Jones & Henry, 1991, executive summary.

[161] "Generally speaking . . . numerous widely distributed, small, confined glacial drift aquifers (less than 1 to 2 square miles in areal extent and less than 50 feet thick) exist in most townships [in Calhoun County]." Moser and Passero, p. 25.

[162] "The bedrock valleys that lie beneath the glacial drift appear to contain thick, extensive alluvial sands and gravels. These semiconfined/confined glacial drift aquifers have considerable potential for future development of groundwater and may be better protected from surface contamination than other glacial aquifers." Moser and Passero, p. 34. Such a large "buried valley" is known to exist northwest of the proposed new wellfield, in the area of Spectacle Lake, and is thought to supply water to the Marshall sandstone in the area where the new wellfield is proposed. Preliminary indications are that it is not within the zone of influence of the proposed wellfield, however.

[163] But 60 of 234 private wells studied by the Michigan Groundwater Survey were in glacial drift deposits. Michigan Groundwater Survey (Calhoun), p. 16.

[164] 98.3% (225 of 229 wells) of the wells tested in Calhoun County by the Michigan Groundwater Survey had hardness at or exceeding 150 parts per million, the threshold of undesirable hardness according to the Michigan Environmental Health Association. Michigan Groundwater Survey (Calhoun), p. 7. 78.6% contained iron and 53% contained manganese exceeding secondary maximum contaminant levels. P. 10.

[165] An impression confirmed by the preliminary analysis of water at the city's favored site. See Section 5.2.3.2.

statistical analyses of the groundwater chemistry of various rock types.[166]

5.1.3 *Wellhead Protection Standards.* In addition to water quality standards which fix the maximum permitted amounts of numerous substances in public water supplies, a 1986 amendment to the federal Safe Drinking Water Act established a voluntary wellhead protection program. States are invited to adopt programs to identify and protect areas around wellfields susceptible of contamination, to identify sources of contamination, to carry out control programs, to develop contingency plans in the event of contamination, and to establish standards to be considered in choosing new well locations.

5.2 *The Specific City of Albion Proposal.* At its meeting September 3, 1996, the Albion City Council considered six options[167] for dealing with long-term issues concerning the water supply. It voted to develop a new wellfield with iron and manganese removal. The matter was brought to the council by the administration then because of impending deadlines. The city's option on the WALM site[168] had not long to run, and the Environmental Protection Bond Implementation Act grant[169] which will pay a large part of the cost was due to expire in October. The construction cost is now estimated at $4.1 million and the total cost (including land, design and engineering work, management, inspection and financing costs) at $4.7 million.[170] The city has contracted with Fishbeck, et al, for preliminary design and engineering work.[171]

5.2.1 *Investigative Study.* The city retained Fishbeck, Thompson Carr & Huber, Ada, Michigan, in 1994 to identify promising sites for a new city wellfield. The resulting report was received in December 1994.[172] Fishbeck, et al, reviewed geological and hydrogeological data, inventoried potential and known sites of contamination, examined local water well records, and sampled a number of residential wells for arsenic, iron and manganese. The study focused on the Marshall sandstone as the most productive aquifer in the area. The engineers concluded,

The most favorable areas for the development of a new well field are in Sections 4, 5, 8 or 9 in

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[166] Pp. 16-25.

[167] The six courses of action were: (1) Build a VOC [volatile organic compound] treatment plant according to the 1991 plan [See Section 4.4] at a cost of $6 to $6.6 million; (2) develop a new three-well field in Albion Township, including a transmission main, but not including any treatment, at a cost estimated at $2.2 million; (3) build a smaller VOC treatment plant at Brownswood Road, without accessory facilities, at a cost of $3.6 million; (4) develop a new two-well field and construct a treatment plant at Brownswood Road to remove iron and manganese, but not hydrocarbons, estimated to cost $4.5 million; (5) develop a new two-well field and construct a treatment plant at the wellfield to remove iron and manganese, but not hydrocarbons, estimated to cost $4 million; and (6) do nothing. The administration eliminated Nos. 1 (as too expensive) and 6 (as irresponsible) and recommended Nos. 3 and 4 as equally acceptable. No. 4 was adopted by unanimous vote.

[168] See Section 5.2.2.

[169] See Section 7.3.3.

[170] See Section 7.3.5.

[171] *Albion Recorder,* "City hires firm for wellfields preparation." Oct. 22, 1996, p. 1.

[172] Fishbeck, Thompson, Carr & Huber. *Alternate Well Field Investigation for City of Albion/Albion, Michigan.* Ada, Michigan 1994.

Albion Township,[173,174] and possibly the western part of Section 32 in Sheridan Township.[175,176]

The study also found the natural quality of water comparable to that of the Brownswood wells and typical of the quality of water from the Marshall sandstone. It had arsenic in amounts below the primary drinking water standard and iron and manganese close to the secondary standards.[177]

5.2.2 *Acquisition of Interest in Land.* City officials have reported spending more than a year attempting to locate available property within the area recommended by the engineers. The city eventually acquired an option on a 10-acre parcel formerly in use as the WALM transmitter site. The location is nearly in the center of the recommended area, in the northwest quarter of Section 9, Albion Township. It is less than a mile along Irwin Avenue (Homer Road or 25½ Mile Road) southwest of the intersection of Finley Drive and Irwin Avenue, and nearly opposite the intersection of B Drive S. and Homer Road.

5.2.3 *Assessment of Proposed Site.*

5.2.3.1 *Availability of Water.* After the city acquired its option, Fishbeck, et al, was engaged to evaluate the site. It performed tests to determine the capacity of the aquifer at the proposed site, and to test the dissolved mineral content of the water there. Its report was made August 15, 1996.[178] A 5-inch well was drilled to 162 feet on the site July 30, 1996, and an 8-inch well to 160 feet July 31 to August 2. The 8-inch well was pumped for about 24 hours, and well recovery was monitored for 16 hours. The smaller well, about 100 feet away, was used to monitor changes in the water table. The test showed that water levels declined less than 0.7 foot in the well being pumped, and less than 0.25 foot in the observation well.[179] The engineers concluded,

> [T]he aquifer is very prolific in this area, and is capable of producing large quantities of groundwater, greater than the current water demands of the City. . . . This analysis indicates that a single well pumping at any rate up to 1,200 g.p.m. will have minimal impact on water levels at the well field and in wells at nearby homes surrounding the well field site. Although the aquifer is capable of producing groundwater at a rate exceeding 1,200 g.p.m., it is not necessary, since lower pumping rates will adequately meet the City's water demands.[180]

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[173] The reference is to government survey sections, each one mile square. A standard survey township is six miles square and consists of 36 numbered sections, with Section 1 at the northeast corner of the township and Section 36 at the southeast corner.

[174] The area bounded by D Drive S., Finley Drive, Division Drive, and what would be the location of 25 Mile Road.

[175] The area bounded by B Drive N. (North River Road), 25½ Mile Road, Division Drive, and what would be the location of 25 Mile Road.

[176] Fishbeck, et al, *Investigation Study,* p. 15.

[177] Fishbeck, et al, *Investigation Study,* p. 13.

[178] Fishbeck, et al. "Re: Albion Alternate Well Field." Letter from Mandle, Richard J., and William E. Kelley, P.E., to Lewis Steinbrecher, Albion city manager, August 15, 1996.

[179] Mandle, et al, letter, p. 2.

[180] Mandle, et al, letter, pp. 2, 3.

5.2.3.2 *Quality of Water at Proposed Site.* Analysis of water samples from the test wells showed iron, manganese and arsenic at levels comparable to those in the Brownswood wells.[181] No organic compounds, pesticides or polychlorinated biphenyls were detected.[182] A long list of inorganic substances was tested for, and in no case other than iron and manganese did the samples exceed applicable standards. There were no indications of any contamination of the water from human activity.

5.2.3.3 *Geology of Wellfield Area.* The 10-acre site acquired by the city is near the center of the area recommended by Fishbeck, et al. It is in a relatively undeveloped area, roughly an equal distance from the south (Homer) branch and the main (west) course of the Kalamazoo River. Groundwater flows in the area are thought to be generally toward the rivers in the drift, or shallow aquifer. The bedrock aquifer in the area is thought to be supplied generally by natural flows from the north and northwest, the Spectacle Lake area. Natural flows into the area are thought to be several times the proposed withdrawal. The zone of contribution of the proposed wellfield is preliminarily thought to be mainly in the area to the south and southwest of the site. Flows in the aquifer will be studied, and the zone of contribution of the proposed wellfield more precisely determined as part of engineering work now in progress.

5.2.4 *Engineering, Design Work.* The engineering and design work in progress[183] as this report is published is expected to be substantially complete in January 1997. The tasks undertaken by the consultants include gathering information, projecting water requirements, determining necessary treatment capacity, analyzing iron and manganese removal requirements, preparing schematic plans for the treatment process, and evaluating pipeline routes. It will develop conceptual plans and cost estimates.

5.3 *Development of Surface Water Sources.* Many municipalities take their water from lakes, reservoirs and rivers.[184] Albion is situated at "the Forks" because of plentiful surface-water resources, which in the 19th Century were especially valuable for water power. The dredging of the millpond on the Homer branch of the Kalamazoo River (upstream from the Haven Road dam) in 1978 and 1979 made available a large impoundment. Apparently no serious consideration has been given to the development of the millpond as a municipal water source, nor has there been any evaluation of its adequacy. Surface water is much more likely to be soft than ground water, but is most susceptible to contamination from agriculture, including livestock; pollution from chemical and petroleum spills, and airborne pollutants. Its adequacy as a source may also be affected by drought and flood. Development of surface-water sources is permitted only when suitable groundwater is not available; at a minimum, filtration and disinfection would be required treatments.[185]

5.4 *Adjunct to Treatment--Improvements to Distribution System.* Further improvements to the distribution system have been suggested by city staff and each of the engineering firms studying the city's

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[181] Mandle, et al, letter, p. 4. The iron and manganese exceeded secondary contaminant levels at 1.1 mg/*l* and 0.084 mg/*l*, respectively. Arsenic at 0.003 mg/*l* was well below the primary standard of 0.05 mg/*l*.

[182] Mandle, et al, letter, p. 3.

[183] See footnote, Section 5.2.

[184] Surface sources are more commonly used where ground water is less plentiful than in southern Michigan. "All water in Calhoun County [sic--all water for public distribution systems?] comes from the ground." Michigan Groundwater Survey (Calhoun), p. 31.

[185] 40 Code of Federal Regulations, Chapter 1, Subpart H.

water system, beginning in 1980 with Ayres, Lewis, Norris & May.[186] Some improvements have been carried out, most recently in 1986, with the replacement of some mains and looping to eliminate dead-ends, and in 1993, with the construction of a new main between Erie Street at Finley Drive and Brownswood Road.[187] In 1991, Jones & Henry recommended the addition of a 1-million-gallon above-ground storage tank,[188] twice the capacity of the present tank. Fishbeck, Thompson, Carr & Huber, in the plan urged by the city administration in 1991, stated, "A new elevated storage tank is not included in this cost estimate although it is advisable that a second elevated tank be constructed; the tank is not essential to the treatment plant."[189]

6 Supply Issues.

6.1 *Projected Needs.* The study committee has found little analysis of the city's future water needs. Present water use is far below historic use,[190] and it seems to be a universal assumption that the water production capacity of the present system is adequate. Ayres, et al, projected daily water use in 2000 at 4.24 million gallons a day.[191] Jones & Henry[192] projected that average water production will increase at 1 per cent a year, but stated no basis for that assumption. The clear trend in Albion has been that water consumption, in particular industrial consumption, continues to decline.[193] There seems to have been no studied projection of future industrial development needs, or residential or recreational needs, by anyone. The city's wellfield development plan is plainly based on an assumption that a production capacity averaging no more than 2 million gallons a day will be sufficient for the foreseeable future.

6.2 *Capacity of Aquifers, Wellfields.* All information available to the study committee suggests that the capacity of the bedrock aquifers in the Albion area is unlimited for all practical purposes. The proposed new wellfield would also draw water from the Marshall sandstone. Results of the preliminary study of the site confirm the presence of groundwater in vast quantities.[194,195]

7 Strategies for Addressing City's Water Needs.

7.1 *Information.*

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[186] Ayres, et al, p. 32. But the Ayres study was concerned with supply and pressure issues as much as quality.

[187] Interview with city staff.

[188] Jones & Henry, 1991, p. 19.

[189] Fishbeck et al, p. 12.

[190] *1992 Water Department Annual Report*, p. 54; additional information requested by committee and furnished by city staff. See Section 2.4.

[191] P. 1. It assumed a population in 2000 of 15,600. P. 7.

[192] Jones & Henry, 1991, p. 2.

[193] See Section 2.4.

[194] See Section 5.2.3.1.

[195] The Clark Street wellfield and the McGraw-Edison air-stripping operation--only about a quarter-mile apart--together take about 5 million gallons a day from the Marshall sandstone without affecting other wells nearby.

7.1.1 *Further Studies Not Needed.* The study committee concludes that there is sufficient understanding of the aquifers, known and likely sources of contamination, and the city's probable needs to support a sound decision about water improvements. That assumes completion of the detailed engineering and design work now in progress. The committee assumes that that work will include a close study of the zone of influence of the proposed wellfield, and of possible sites of contamination around it. That includes the old dump reported to have been located at Erie and 25½ Mile Road and possible contamination from oil field activities, including brine disposal.

7.1.2 *Demand.* The committee finds no reason to doubt the assumption that city water demands are unlikely to increase remarkably in the short term. However, there needs to be deliberate consideration of future water demands. The preliminary design and engineering work now in progress should address the question.

7.1.3 *Education of the Public.* Consensus on strategies for securing and maintaining safe water supplies requires an informed public. This report may serve as one resource for informing the public.

7.2 *Political Issues.* Public water systems may be controversial because of cost, health concerns, and even civil libertarian issues.[196] The city's plan to develop a remote wellfield in Albion Township has brought an additional political constituency into the debate--the township residents. Initial reaction by some residents to the city's plans when presented at a public meeting November 6, 1996, was negative, even hostile. The Albion Township board is investigating its options in regulating the city's plans, including possible amendment of its zoning ordinance. The city has invited Albion Township to open negotiations on an agreement concerning the wellfield development, but as of the date of this report has not received a response.

7.3 *Financial Issues.* Albion's water rates are among the lowest in Michigan. They are expected to remain so even after rates are increased because of the wellfield and treatment project.[197] The city is now studying the rate impact of the proposed wellfield development and treatment plant construction. It has estimated the likely changes in rates.[198] The city charter requires that the water utility pay its way, including depreciation.[199] In general, these means are available to underwrite the cost of building and operating municipal water facilities:

7.3.1 *General Obligation Bonds.* The municipality may borrow money to build the facility

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[196] Fluoridation of Albion's water began only after years of debate and a hotly contested election Sept. 28, 1965, on an initiative charter amendment that would have prohibited the City Council from treating the water with fluoride. The amendment was defeated, 1,194 to 767, and fluoridation began about four months later. *Albion Evening Recorder*, "City Now Adding Fluoride to Water." Jan. 29, 1966. At least two opponents of fluoridation responded by drilling private wells. *Recorder*, "No Fluoride for Him." Dec. 15, 1965; "Of Local Interest." Dec. 20, 1965.

[197] "This borrowing will cost the average homeowner of a $45,000 house about $18 to $20 a year. That's about $1.50 a month. Compared to the cost of buying distilled water or one new white shirt, that is considered very affordable. The new iron removal plant will eliminate staining of the water which discolors clothing when it is repeatedly washed." Informational memo, "Financing Albion's Water Project." Lewis J. Steinbrecher, city manager, December 1996.

[198] See table in Appendix C.

[199] Section 17.3 of the City Charter states, "The rates and charges for any municipal public utility shall be so fixed as to at least meet all the costs of such utility, including depreciation."

and repay the money from property tax revenues.[200] The additional levy must be approved in an election.

7.3.2 *Revenue Bonds.* The municipality may borrow money to build the facility and repay the money from revenues of the water system.

7.3.3 *Government Grants.* The city has been offered $500,000 under the Environmental Protection Bond Implementation Act[201] to explore the possibility of constructing a water treatment plant for removal of gasoline and other volatile hydrocarbons from the Brownswood well field.[202] Part of that has been spent on the Brownswood aquifer study. Lobbying efforts undertaken by Albion College resulted in an appropriation of $900,000 in Department of Housing and Urban Development funds.[203] Of that, nearly $200,000 was spent on the 1993 Erie Street-Brownswood water main connection. There may be other state and federal sources of funds for water quality improvement.

7.3.4 *Private Grants.* The board of trustees of Albion College has expressed a commitment to the cause of improving Albion's water. In addition to the lobbying activity it underwrote, the college paid $62,500 of the cost of the Brownswood aquifer study.[204]

7.3.5 *Combination Financing--The City's Specific Financing Plan.*[205] The City of Albion plans to use a combination of funding sources for the pending project. Of the $4.7 million projected total cost, in round numbers $500,000 will come from the State of Michigan grant,[206] $700,00 from the funds remaining from the Housing and Urban Development appropriation,[207] and $1.8 million from revenue bonds which have already been approved. The City Council has scheduled an election January 28, 1997, on the question of general obligation bonding to fund the rest--about $1.7 million--of the development and construction cost.[208]

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[200] 77% of respondents to the open-ended community survey conducted in 1990 said Albion should improve water quality even if it means a tax increase. Albion, Express Yourself! Committee. *Summary Report of the Albion, Express Yourself! Community Survey* (draft edition). 1990, p. 41.

[201] 1988 P.A. No. 328; it carries out the mandate of ballot Proposal C in the 1988 general election, authorizing the sale of $660 million in general obligation bonds to finance environmental protection programs, clean up sites of toxic contamination, and contribute to a regional Great Lakes protection fund, among other stated purposes.

[202] A contract approved by the Albion City Council Oct. 7, 1991, provides for the money to be used for the construction of a system to treat the Brownswood contamination. The offer to the city was broader, however, and encompassed the investigation of alternate sources, as well. Howard, Alan J., chief, Environmental Response Division, Michigan Department of Natural Resources. "Re: Bond Funds Authorization, Brownswood Well Field, Calhoun County." Letter to Jon W. Bloemker, Division of Water Supply, Michigan Department of Public Health. July 12, 1991.

[203] *Albion Recorder,* "House Oks $900,000 for Albion water plant," September 29, 1992, p. 1.

[204] See Section 3.2.5.1.

[205] Memo of Lewis J. Steinbrecher, city manager. "Albion Municipal Water Improvement Project/Sources and Uses of Funds." December 1996.

[206] See footnote, Section 5.2.

[207] See Section 7.3.3.

[208] *Albion Recorder,* "Water rates bond election set for Jan. 28." Oct. 3, 1996, p. 1. A notice to voters published in the *Albion Recorder* December 9, 1996, quoted the proposal to be put to the electorate: "Shall the City of Albion, Calhoun County, Michigan, borrow a sum of not to exceed one million seven hundred thousand dollars ($1,700,000) and issue its general obligation unlimited

7.4 *Technical Issues.* There appear to be no technical obstacles to the production of ample quantities of water or to the treatment of available groundwater to whatever standards are chosen.

8 Committee Findings, Recommendations and Comments.

8.1 *Findings of Fact.* The committee makes these findings:

8.1.1 Complaints about the City of Albion's municipal water are serious and persistent. There are credible reports that people have declined to move here and that prospective students have declined to enroll at Albion College because of them.

8.1.2 The complaints of consumers about the quality of water furnished by the City of Albion's municipal water system arise chiefly from the presence of iron and manganese which occur naturally in the water. The complaints have to do with the aesthetic qualities of the water, not with its safety.

8.1.3 The City of Albion now provides a safe potable water supply. Its ability to do so in the future is substantially threatened by several known and suspected sites of soil and groundwater contamination. Contamination of the municipal water supply could significantly impair other efforts to improve the community, attract new businesses, and persuade people to live and students to enroll here.

8.1.4 The region has a vast supply of groundwater. The capacity of the aquifer is more than ample for all present and foreseeable uses.

8.1.5 The city's present water rates are so low that it should be possible to sell even an expensive water-system improvement to an informed public. Water rates could be increased several times without being unreasonably high.

8.1.6 Approximately two thirds of the financing needed for the proposed wellfield and treatment plant development is in place. Approval of bonding for the balance awaits a favorable vote of Albion citizens.

8.1.7 Water supply and water quality are natural resource issues that are best understood in terms of regional geography and geology, not political boundaries.

8.1.8 There is no evidence that the wellfield development proposed by the City of Albion will affect either the quality or quantity of water available in the surrounding area.

8.1.9 Efforts to protect groundwater, a prudent and necessary accompaniment to the proposed wellfield development, will benefit township and city alike.

8.2 *Recommendations.* The committee made these recommendations to the Greater Albion

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tax bonds therefore [sic] for the purpose of paying part of the cost of acquiring and constructing additions and improvements to the city's water supply and sewage disposal system, including the development of a new well field, construction of new transmission lines and the acquisition and construction of an iron and manganese removal plant, together with interests in land and all appurtenances and attachments thereto?"

Alliance 2000, which were adopted December 4, 1996:

8.2.1 Ensuring a reliably safe supply of palatable water is critical to the development and improvement of the Albion area. The Greater Albion Alliance 2000 should determine that the development of a new wellfield and construction of appropriate treatment facilities should proceed with the full support of the greater Albion community. City water rates will increase, but the increase will be modest and the benefit is worth the cost.

8.2.2 The Greater Albion Alliance 2000 should publicly support the city administration's plan to develop a new wellfield and construct an iron- and manganese-removal plant. Its support should be conditioned only upon the completion of preliminary design and engineering work confirming the feasibility of the plan and suitability of the location.

8.2.3 The Greater Albion Alliance 2000 should support the pending general obligation bond issue to raise the amount required in addition to the grants and appropriations also available. The Alliance should establish a committee to inform the public and promote a favorable vote.

8.2.4 The Greater Albion Alliance 2000 should undertake to educate people in the greater Albion area about water as a dynamic resource, critical to the future economic stability and prosperity of the area, and requiring the stewardship of all.

8.2.5 The Greater Albion Alliance 2000 should encourage and, if appropriate, assist the City of Albion and Albion Township in developing a regional water resource protection program.

8.2.6 The Greater Albion Alliance 2000 should arrange for the reproduction of this report in sufficient quantities to make copies available to be borrowed and read by the public at the Albion Public Library, the Albion College Library, City Hall, the Albion Township Hall, the Greater Albion Chamber of Commerce, the Albion Volunteer Service Center, the Albion Recorder, and each public school, and to be furnished to elected officials in the City of Albion and Albion Township. Copies of a summary version of the report should be made available at no cost to all who are interested.

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ALBION'S MUNICIPAL WATER

TOPOGRAPHIC MAP OF ALBION AND VICINITY
MAP EXPLANATION

○	WELL FIELDS FOR MUNICIPAL WATER SUPPLY
CW	Clark St. Well Field
BW	Brownswood Rd. Well Field
IW	Irwin Ave. Proposed Well Field
△	SITES OF FORMER MUNICIPAL LANDFILLS
SAT	Sheridan-Albion Twp. Site
MP	McIntosh Park Site
HS	Harrington School Site
WE	West Erie Rd. Site
□	MAJOR INDUSTRIAL SITES
BF	Brooks Foundry, Inc. (inactive)
CI	Cooper Industries
HAI	Hayes Albion Industries
USP	Union Steel Products (inactive)
GI	Guardian Industries

Appendix A

SCALE 1:24 000

1 0 1/2 0

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

BROWNSWOOD WELL WATER
TEST RESULTS

Date	Well No.	Chemical	Concentration (ug/l)	SDWA MCL (ug/l)
12/06/88	1	*MTBE	1.0	NR
12/06/88	3	Benzene	1.0	5.0
04/04/89	1	Dichlorodifluoromethane	1.3	NR
04/04/89	1	MTBE	1.0	NR
04/04/89	2	MTBE	2.0	NR
11/13/89	3	MTBE	2.0	NR
12/18/89	3	MTBE	16.9	NR
12/18/89	3	Benzene	1.0	5.0
12/18/89	3	Benzene	1.2	5.0
01/25/90	1	MTBE	1.0	NR
01/25/90	3	MTBE	2.0	NR
02/08/90	3	MTBE	1.1	NR
05/22/90	1	Chloroform	2.0	NR
09/13/90	1	Toluene	0.6	2000
09/13/90	1	MTBE	5.0	NR
09/13/90	1	Dichlorodifluoromethane	2.5	NR

NR = Not Regulated

*MTBE = methyl tertiary butyl ether

Appendix B

Comparative Water Rates, Selected Michigan Cities

December, 1996

City	*Rate per 100 cubic feet* (1 cubic foot = 7.48 gallons)		*Volume Category*
	Basic Rate	**Volume Rate**	
Albion (present rate)	$0.31		1-20,000 cubic feet
		$0.30	20,001-50,000 cubic feet
		$0.29	over 50,000 cubic feet
Albion (projected rate in 2000)	$0.43		1-20,000 cubic feet
		$0.42	20,001-50,000 cubic feet
		$0.40	over 50,000 cubic feet
Saline	$0.49		1-668 cubic feet
		$0.65	669-13,369 cubic feet
		$0.78	over 13,369 cubic feet
Charlotte	$0.67		flat rate
Battle Creek	$0.91		flat rate
Hastings	$1.00		flat rate
Adrian	$1.04		flat rate
Jackson	$1.05		1-10,000 cubic feet
		$0.79	10,001-100,000 cubic feet
		$0.50	100,001-1,000,000 cubic feet
		$0.45	over 1,000,000 cubic feet
Coldwater	$1.29		1-133,690 cubic feet
		$1.14	over 133,690 cubic feet
Eaton Rapids	$1.42		1-400 cubic feet
		$0.93	over 400 cubic feet
Marshall	$1.52		1-1,000 cubic feet
		$1.25	1,001-3,000 cubic feet
		$0.90	3,001-15,000 cubic feet
		$0.78	15,001-400,000 cubic feet
		$0.66	over 400,000 cubic feet
Dexter	$1.55		flat rate

Appendix C